The Society for the Study of Inebriety

THE THIRD

NORMAN KERR MEMORIAL LECTURE

ON

THE INFLUENCE OF ALCOHOL ON IMMUNITY

BY

PROFESSOR TAAV. LAITINEN, M.D.

Professor of Hygiene and Director of the Hygienic Institute in the University of Helsingfors, Finland; and Member of the Finnish National League of Health

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Delivered in connection with the Twelfth International Congress on Alcoholism, in the Theatre of the Victoria and Albert Museum, South Kensington, on Tuesday, July 20, 1909

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THE THIRD NORMAN KERR MEMORIAL LECTURE.*

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BY PROFESSOR TAAV. LAITINEN, M.D.

Professor of Hygiene, Director of the Hygienic Institute of the University, Member of the Finnish Academy of Science.

LADIES AND GENTLEMEN,

My first duty is to express my sincere appreciation of the honour which the President and Council of the British Society for the Study of Inebriety have done me in inviting me to deliver the Third Norman Kerr Memorial Lecture. It is a high privilege to be allowed a part in the preservation of the memory of a distinguished physician whose scientific work in regard to the study of inebriety is known and valued throughout the world.

May I also tender my thanks for the opportunity of delivering this lecture in connection with an occasion so important as a gathering of the International Congress on Alcoholism in the Metropolis of Great Britain.

Modern researches have done much to explain the extent and nature of the protective powers by which the organism endeavours to defend itself against the attacks of all kinds of injurious agencies, and especially against invasion by the germs of infective diseases. It is now a well-established fact that alcohol

* Delivered in the Lecture Theatre of the Victoria and Albert Museum, South Kensington, London, Tuesday evening, July 20, 1909.

weakens the normal resisting power of the body against the above-named disease-producing influences. In the hope of contributing something to the explanation of the way in which alcohol weakens the organism, I have made a number of experiments bearing upon the question of the influence of alcohol on immunity.

Early in the present century careful experiments went to show that alcohol certainly had some influence upon immunity. Two Americans, Abbot and Bergey,* were the first to discover that this agent produces a diminution of the hæmolytic complement in the blood-serum of certain animals which were tested. They showed also that the formation of specific hæmolytic receptors (immune bodies) may be retarded by the action of alcohol. C. Fraenkel,† however, asserts that both large and small quantities of alcohol exercise a definite stimulant action upon the formation of the immunizing bodies.

R. Trommsdorff‡ has described a retarding influence exerted by alcohol upon the formation of agglutinins in guinea-pigs. Rubin§ speaks of the negative action of alcohol upon phagocytosis in the case of staphylococcus, streptococcus, and pneumococcus. E. Stewart|| has noted the effects of alcohol upon the opsonic index for tubercle bacilli and also streptococci.

Almost similar results have been obtained by P. Th. Müller,¶ Friedberger,** and others in regard to the influence of alcohol on the protective qualities of the blood generally.

In former communications†† I have shown that the power of resistance of the red blood-corpuscles, as well as, to some extent, the bacteriocidal power of the blood-serum, is lowered by alcohol. On the contrary, J. Leva,‡‡ who, however, made comparatively few experiments, and these in a totally different manner from mine, could not find any influence upon the formation of anti-bodies by

* Abbott and Bergey: *University of Pennsylvania Medical Bulletin*, 1902.

† Fraenkel, C.: *Berliner Klin. Wochenschrift*, 1905, p. 53.

‡ Trommsdorff, R.: *Archiv für Hygiene*, Bd. LVIII.

§ Rubin, *Journal A. M. A.*, vol. xlviii., No. 17, p. 1432.

|| Stewart, E.: *American Journal of Inebriety*, 1907.

¶ Muller, P. T.: *Wiener Klin. Wochenschrift*, No. 77, 1904.

** Friedberger: *Berliner Klin. Wochenschrift*, 1904, p. 242.

†† Laitinen, T.: "Bericht über XI. Internationaler Kongress gegen den Alcoholismus," 1907; and *Zeitschrift für Hygiene*, 1907.

‡‡ Leva, J.: *Medicinische Klinik*, No. 16, 1907, p. 450.

the so-called "typhus bacteria in rabbits." E. Friedberger and H. Doepner,* likewise making very few experiments, and again by a method different from mine, state that they have not remarked any diminution in the normal power of resistance of the red blood-corpuscles in animals tested. These last-named experiments I have already criticized elsewhere, and have endeavoured to show that they really tend to support my own conclusions.†

Interesting in this respect are the physiological researches of R. Hunt, and the histological researches of E. A. Homén,‡ on tuberculosis and alcohol.

The extent of the evil effects upon the human body resulting from the consumption of alcoholic beverages is as yet far from being fully known, and stands in need of scientific verification. Many other injurious influences, of course, such as insanitary dwellings, bad feeding, excessive toil, and toxic agents like nicotine, etc., may produce somewhat similar morbid effects. It is therefore necessary, in the scientific study of the question, to take these possibilities into consideration. In my investigations, the results of which I am now to lay before you, I have endeavoured to select as subjects for my experiments both abstainers from alcohol and those who indulge more or less in its use, in such a way that their conditions of life and their habits in other respects should be as nearly as possible the same. All persons, for instance, suffering from any acute or chronic disease were rejected, and very few of the persons selected were smokers. The subject of this research has been human blood, and especially its two principal components, namely, red blood-corpuscles and blood-serum, both of which up to the present time have been very little studied in relation to the question under discussion. I have gone into these matters chiefly because the modern theoretical study of immunity during the last few years has, in general, attracted greater attention to the blood, and shown the important rôle which the different parts, properties, and capacities of the blood play in defending the organism against internal and external injurious agencies. Further, the subtle methods employed in the study of immunity (such as organic reactions, and reactions between greatly attenuated organic liquids) would also seem to be available for our purpose,

* Doepner, H. : *Centralblatt für Bakteriologie*, Bd. XLVI., Heft 5.

† Laitinen, T. : *Centralblatt für Bakteriologie*, Bd. XLVIII., Heft 5, 1908.

‡ Homén, E. A. : MSS. of a Paper to be read at the International Medical Congress, Budapest, this year.

as they allow of the detection of the minutest differences which alcohol may produce in any part of the organism in question. I felt, moreover, that it would be exceedingly interesting, from a mere theoretical point of view, to learn how the normal power of resistance to—that is, the normal immunity from—say, infective diseases, can be diminished by alcohol even in small quantities—a change which has before been shown to take place both by myself and by various other authors. The present research, it is hoped, may perhaps throw some light upon the matter.

During the course of my research, which has lasted over a period of three years, I sought to investigate:

THE ACTION OF ALCOHOL ON THE RESISTIVE POWER OF HUMAN RED BLOOD-CORPUSCLES.

I wished to ascertain whether the resistivity of the red blood-corpuscles in a healthy man could be lowered by the consumption of alcohol. In my paper read before the last International Congress against Alcoholism at Stockholm, I showed, among other things, that the resistive power of red blood-corpuscles, as observed in the animals tested, against a heterogeneous serum was diminished by alcohol, given even in small quantities. In a still earlier publication,* which appeared nine years ago, I showed that alcohol has no influence upon the number of red blood-corpuscles, nor upon the quantity of hæmoglobin contained in them, and therefore it is doubly interesting to ascertain if the resistance of the cell (the red blood-corpuscle) itself is affected or not by the consumption of alcohol.

I have now tried to determine:

THE HÆMOLYTIC POWER OF BLOOD-SERUM IN ALCOHOL-DRINKING AND OF ABSTINENT PERSONS RESPECTIVELY

in the presence of heterogeneous red blood-corpuscles—in this instance, those of rabbits. We may well suppose that the human blood-serum may be so influenced by the consumption of alcohol that its hæmolytic power is diminished, or, at least, affected. If a diminution were detected, it would, in my opinion, signify a deterioration in the blood-serum. I investigated not only the hæmolytic power of the human blood-serum, but also its power of precipitation in the presence of rabbit-serum. I wished to ascertain whether the reaction between a known dilution of rabbit-serum and a certain dilution of the serum of alcohol-drink-

* Laitinen: Acta societatis scientiarum Fenniæ, Tom. XXIX., No. 7.

ing, and also of abstinent, persons would differ; also whether the reaction was more apparent in the former or in the latter.

ALCOHOL AND IMMUNE SERUM.

The resisting power of serum, obtained both from alcohol-drinking and from non-drinking persons, was further tested by means of immune serum of rabbits (immunized by human blood-serum) with the object of discovering whether there was any difference in reaction between the same immune serum and the two kinds of human sera above mentioned respectively. I have studied the problem as to whether the hæmolytic complement in the blood-serum of alcohol-drinking and of abstinent persons is in any way altered.

The bactericidal power of blood-serum from both alcohol-drinking and non-alcohol-drinking persons was experimentally determined.

OBSERVATION ON HUMAN SUBJECTS.

In the course of my investigations I have examined blood from *two hundred and twenty-three* persons. They were of different classes and ages. There were professors of medicine and other physicians, University Fellows, students of both sexes, hospital nurses, school-masters and school mistresses, waiters, and other men and women belonging to the working-classes.

I will now now describe my

EXPERIMENTS UPON THE RESISTING POWER OF RED BLOOD-CORPUSCLES.

Human blood for my experiments was usually taken from the median vein of the left arm, the skin having been first rendered aseptic with boiled water, alcohol and ether. In animals the blood was taken either from the ear or from the carotid vessels. The blood-corpuscles were separated from the serum by means of a centrifuge, and the corpuscles were washed three times with 0·8 per cent. salt solution.

As lysin for the human blood-corpuscles I have used both normal rabbit serum and also the serum from rabbits which had been immunized with red human blood-corpuscles, after these had been washed as before described. The immunization of the rabbits took place in the following manner: I injected subcutaneously red blood-corpuscles mixed with 50 per cent. physiological saline solution, at first in smaller, and afterwards in larger doses, during a period of from six to eight weeks. When the immunity had reached the required degree, as shown in the

accompanying tables, blood from each animal was drawn and centrifugalized. The serum, thus absolutely freed from all corpuscles, was incubated at a temperature of 56° C., and in a quantity sufficient for use in all experiments of the various series, it being very difficult to secure, in any other way, serum of the same hæmolytic and fixative power.

As complement in the experiments with immune serum fresh guinea-pig serum was used in quantities of 0·2 c.cm.

The human red blood-corpuscles were used for the hæmolytic experiments in a 10 per cent. dilution. Of this dilution 1 c.cm. was taken for every test-tube, and to it was added the lysin, diluted according to requirements, and also the complement, except in cases where normal serum was used; and, lastly, physiological saline solution was added to make up the quantity in every test-tube to 2 c.cm. The contents of the test-tubes were thoroughly mixed with a melangeur (mixer), and then placed in an incubator at 37° C. for two hours, during which time they were repeatedly well shaken. The test-tubes were afterwards placed in a refrigerator for eighteen to twenty hours, after which the degrees of hæmolysis were compared and noted by means of a scale specially made for each experiment. To make a scale corresponding to a dilution of 5 per cent. of red blood-corpuscles, I took 1 c.cm. defibrinated blood to 39 c.cm. water, and lowered the red colour—caused by the total hæmolysis of the red corpuscles, and set down as 100 per cent.—with a 0·8 per cent. salt solution, down to 95 per cent., 90 per cent., 85 per cent., 80 per cent., and so on to 0·5 per cent.: and from 20 per cent. downwards, with intervals of 1 per cent. and 0·5 per cent., so that every test-tube of the same calibre as that used in the experiments contained 2 c.cm. To make the scale corresponding to a dilution of 10 per cent., I took 1 c.cm. defibrinated blood to 19 c.cm. water, and proceeded as above described.

It will be well for me here to explain that in this lecture I mean by the term "drinker" a person who has taken alcohol in any quantity whatever. Many of these "drinkers" therefore were, in fact, most moderate consumers of alcohol. By the term "abstainer" I mean a person who has never taken alcohol in any quantity worth mentioning, one whom in this country you would call a "teetotaller."

In the following tables I have endeavoured to express in convenient form some of the chief results of my observations.

TABLE I.—DRINKERS.

1 c.c. of 10 per Cent. Suspension Human Blood-Corpuscles.

Number of Person.	Quantity of Normal Rabbit Serum.—Degree of Hæmolysis.											
	0·4	0·3	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
1	25	20	15	10	7·5	5	2·5	0·5	—	—	—	—
2	20	15	7·5	3	2·5	1·5	?	—	—	—	—	—
3	80	70	45	30	25	10	7·5	1	—	—	—	—
4	95	60	20	7 5	7·5	5	2·5	1	?	—	—	—
5	60	40	35	15	7·5	5	3	2	—	—	—	—
6	100	90	70	50	30	15	2·5	1·5	1	1	—	—
7	7	5	3	2·5	1	1	—	—	—	—	—	—
8	85	70	50	25	15	5	1	1	—	—	—	—
9	85	50	30	30	20	6	—	—	—	—	—	—
10	100	100	60	35	22	10	1	1	—	—	1	—
11	50	40	25	12	10	5	3	1	—	—	—	—
12	30	17	5	3·5	2·5	2	1	1	—	—	—	—
13	60	45	40	3	2·5	2	1	—	—	—	—	—
14	30	20	15	10	6	3	1	—	—	—	—	—
15	20	10	8	5	5	2·5	1	1	—	—	—	—
16	10	6	2·5	1	1	—	—	—	—	—	—	—
17	4	2·5	1	1	—	—	—	—	—	—	—	—
18	13	12	8	5	5	4	1	—	2·5	1	—	—
19	20	16	11	7	5	2·5	1	—	—	—	—	—
20	20	17	7·5	5	3	1	—	—	—	—	—	—
21	50	40	30	20	15	4	1	—	—	—	—	—
22	4	4	2·5	2	2	1	—	—	—	—	—	—
23	20	3	2	1	—	—	—	—	—	—	—	—
24	80	60	40	25	20	12	4	2	1	—	—	—
25	50	40	25	10	5	3	2·5	—	—	—	—	—
26	20	10	5	2	1	—	—	—	—	—	—	—
27	50	30	15	13	9	2·5	3	2	2	1	—	—
Average percentage	44·00	33·06	21·74	12·35	8·52	4·00	1·46	0·56	0·24	0·11	0 04	—

TABLE II.—ABSTAINERS.

1 c.c. of 10 per Cent. Suspension Human Blood-Corpuscles.

Number of Person.	Quantity of Normal Rabbit Serum.—Degree of Hæmolysis.											
	0·4	0·3	0·2	0·1	0·08	0·06	0·04	0·02	0·01†	0·008	0·006	0·004
28	35	30	15	10	9	7·5	3	?	—	—	—	—
29	60	55	40	20	10	10	7·5	5	?	—	—	—
30	100	100	80	30	20	10	7·5	5	?	—	—	—
31	40	25	20	10	10	5	0·5	?	—	—	—	—
32	45	40	30	10	7·5	5	5	2·5	—	—	—	—
33	20	15	12	7·5	7·5	6	2·5	?	—	—	—	—
34	100	95	80	40	30	20	10	5	?	—	—	—
35	75	5	7·5	5	5	2·5	1	?	—	—	—	—
36	30	25	20	10	6	3	1·5	?	—	—	—	—
37	35	25	7·5	5	2·5	1.5	—	—	—	—	—	—
38	85	55	30	20	10	5	1·5	—	1	—	—	—
39	55	45	25	18	15	3	—	1	—	—	—	—
40	15	11	8	6	2·5	1	1	—	—	—	—	—
41	55	45	45	20	20	10	4	1	—	—	—	—
42	75	55	40	20	15	5	—	—	—	—	—	—
43	5	2·5	1	—	—	—	—	—	—	—	—	—
44	25	17	3	2	—	—	—	—	—	—	—	—
45	35	18	10	7	2·5	2·5	1	1	—	—	—	—
46	30	20	6	3·5	3	2	1	—	—	—	—	—
47	45	30	5	17	5	2·5	1	—	—	—	—	—
48	50	15	4	2	4	2	1	—	—	—	—	—
49	45	35	25	15	10	7	1	1	—	—	—	—
50	4	2·5	1·5	1	1	—	—	—	—	—	—	—
51	80	55	35	20	13	5	1	—	—	—	—	—
52	10	5	5	2·5	2·5	1	2	—	—	—	—	—
53	25	10	3·5	2·5	1	—	—	—	—	—	—	—
54	35	15	4	3	2·5	—	—	—	—	—	—	—
Average percentage	42·46	31·85	20·85	11·37	7·94	4·32	1·96	0·80	0·04	—	—	—

TABLE III.—BEFORE ALCOHOL DRINKING.

1 c.c. of 10 per Cent. Suspension Human Blood-Corpuscles.

Number of Person.	Quantity of Normal Rabbit Serum.—Percentage of Hæmolysis.											
	0·4	0·3	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
55	60	55	40	20	10	10	7·5	—	—	—	—	—
56	100	100	80	30	20	10	7·5	—	—	—	—	—
57	40	25	20	10	10	5	1	—	—	—	—	—
58	45	40	30	10	7·5	5	5	2	—	1	1	1
59	20	15	12	7·5	7·5	6	2·5	—	—	—	—	—
60	25	17	3	2	—	—	—	—	—	—	—	—
Average percentage	48·33	42·00	30·83	13·25	9·17	6·00	3·92	0·33	—	0·17	0·17	0·17

AFTER ALCOHOL DRINKING.

Number of Person.	Quantity of Normal Rabbit Serum.—Percentage of Hæmolysis.											
	0·4	0·3	0·2	0·1	0 08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
55	100	80	50	35	25	20	10	—	—	—	—	—
56	45	30	5	17	5	2·5	1	—	—	—	—	—
57	30	20	6	3·5	3	2	—	—	—	—	—	—
58	100	60	40	25	20	18	7	1	—	—	—	—
59	55	45	45	20	20	10	4	1	—	—	—	—
60	75	55	40	20	15	5	1	—	—	—	—	—
Average percentage	67·5	48·33	31·00	20·08	14·67	9·58	3·83	0·33	—	—	—	—

TABLE IV.—DRINKERS.

1 c.c. of 10 per Cent. Suspension Human Blood-Corpuscles.

Number of Person.	Quantity of Immune Serum from Rabbits.—Percentage of Hæmolysis.											
	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
61	100	70	47	25	8	6	5	3	3	3	2·5	2·5
62	50	35	20	7	2·5	2·5	1	1	1	—	1	1
63	75	40	30	15	12	10	10	6	6	5	5	6
64	75	55	40	17	10	7	5	3	2·5	2·5	2·5	2·5
65	80	60	40	18	8	5	2·5	1	2·5	2·5	2	1
66	100	75	60	25	20	12	7	7	5	5	5	5
67	100	80	45	22	12	8	5	4	3	3	4	5
68	40	30	20	7	5	3	3	2	1	1	1	1
69	50	35	30	13	8	5	4	3	2·5	2·5	2·5	2·5
70	20	15	10	3	2·5	2	2·	—	—	—	—	—
71	80	65	45	27	8	10	10	12	5	5	3	2
72	15	3	2·5	1	4	—	1	1	—	—	—	—
73	100	80	40	30	27	27	20	10	5	3	3	3
74	100	80	45	37	15	15	13	8	7	7	7	1
75	45	25	15	10	8	7	7	5	5	5	5	5
76	55	35	35	20	20	10	8	8	7	8	7	7
Average percentage	67·81	48·94	32·78	17·31	10·63	8·09	6·47	4·63	3·47	3·28	3·16	2·77

TABLE V.—ABSTAINERS.

1 c.c. of 10 per Cent. Suspension Human Blood-Corpuscles.

Number of Person.	Quantity of Immune Serum from Rabbits.—Percentage of Hæmolysis.											
	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
77	70	60	24	8	7	5	5	7	6	5	8	8
78	40	20	35	17	10	5	5	2	2	1	2·5	—
79	20	15	17	17	15	12	10	7·5	7·5	7	7	5
80	80	55	45	23	13	7	5	2·5	2·5	2·5	2·5	2·5
81	75	55	33	20	25	13	7	5	3	5	3	2·5
82	80	60	43	15	8	5	4	2·5	1	1	1	1
83	100	100	70	30	25	18	12	10	8	7	7	7
84	25	15	5	10	2·5	2·5	2	—	—	—	—	—
85	50	35	30	25	7	10	12	5	3	4	2	2
86	18	4	2·5	2	2	—	—	—	—	—	—	—
87	60	80	45	15	8	2·5	5	2·5	1	3	2	2
88	85	75	50	15	6	7	1	2	1	2	1	1
89	100	65	25	25	3	3	2	1	2	—	—	—
90	100	100	70	23	13	7	5	5	5	3	3	3
91	35	20	14	15	6	7	5	5	4	2	2	2
92	25	13	8	8	7·5	7	7	4	3	3	3	3
Average percentage	60·19	48·25	32·28	16·75	9·88	6·94	5·44	3·81	3·06	2·84	2·74	2·38

TABLE VI.

1 c.c. of 10 per Cent. Suspension of Human Blood-Corpuscles.

Description and Number of Person.	Quantity of Immune Serum from Sheep.—Percentage of Hæmolysis.											
	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 93	25	13	8	8	7·5	7	7	4	3	3	3	3
Moderate 34	45	25	15	10	8	7	7	5	5	5	5	5
Drinker 95	55	35	35	20	20	10	8	8	7	8	7	7

If we study Tables I. and II., the former showing the resisting power of red blood-corpuscles of drinkers, and the latter that of abstainers, against a normal heterogeneous (rabbit) serum, we find that the results in different persons varied very much, owing both to the difference in the resisting power of their blood-corpuscles, and also to the difference in the hæmolytic activity of the sera used in the different cases. I must, however, add that the same serum was always used to test equal numbers of drinkers and abstainers (usually only one of each).

Despite these great variations, we find, on comparing both sides, *that the average percentage of hæmolysis in twenty-seven cases of drinkers is somewhat greater than that in twenty-seven cases of abstainers, determined in exactly the same manner.* The difference between the different cases was certainly greater than the difference between the average percentages.

If we look at Table III., we find the great variations above mentioned, but we discover also that the average percentage of hæmolysis of blood-corpuscles taken from six women, who had up to that time been total abstainers, was *less before* they had taken alcohol than afterwards. The alcohol was taken for a period of sixty-three days, in quantities of 8 to 10 c.cm. daily, in the shape of 80 to 100 c.cm. of wine of 10 per cent. alcoholic strength.

Looking at Tables IV. and V., we notice that further great hæmolytic differences occur in the various persons, although the incubated immune serum used in these experiments was absolutely the same in all these thirty-two cases. The fresh guinea-pig serum used as complement in quantities of 0·2 c.cm. was, of course, always new for the corresponding cases. Here again we find the same fact that the *hæmolysis of blood-corpuscles from drinkers is slightly greater than that in the case of abstainers.* The difference is certainly very small, but it is noticeable in nearly every dilution of lysin.

Table VI. is also interesting: it shows the hæmolysis of blood-corpuscles taken from three persons well known to me, all more than fifty years of age, one an *abstainer*, one a *moderate*, and one an excessive, *drinker*. Here again we note, as before, that the *hæmolysis of blood-corpuscles from the abstainer was noticeably less than that from the moderate, which in its turn was less than that from the excessive, drinker.*

We see now that all these four different series of tests proclaim with a curious regularity the greater hæmolysis of blood-corpuscles taken from drinkers than from abstainers. The difference is not great, and not always visible, especially in the higher dilutions of lysin; but it is clearly noticeable in the greater number of dilutions, and by no single series of experiments is it contradicted. I cannot conceive as a possibility that all these four different series of experiments could agree in giving results contrary to fact.

On the strength of these experiments I assert that the resistive power of red human blood-corpuscles against a heterogeneous normal serum, or against an immune serum, is somewhat lessened by the consumption of alcohol. That the resistivity of the red corpuscles of animals is thus lessened I stated for the first time in my paper at Stockholm.

We turn now to

THE INFLUENCE OF ALCOHOL UPON HUMAN BLOOD-SERUM, AND (*A*) TO ITS INFLUENCE UPON THE HÆMOLYTIC POWER OF THE SERUM.

In order to discover whether alcohol has any influence upon human blood-serum, I first endeavoured to discover whether the hæmolytic power of the blood-serum diminished or in any way changed, as a consequence of the consumption of alcohol. For that purpose I let the blood-serum from drinkers and abstainers in different dilutions operate upon a 5 per cent. suspension of fresh red blood-corpuscles drawn from rabbits, and taken always about the same length of time before the experiment. The human blood was also drawn about the same length of time before the experiment.

The results of these experiments are indicated in Tables VII., VIII., IX. and X. By studying these it will be seen that the results of the various experiments are dissimilar, owing, perhaps, both to the difference in the resistivity of red blood-corpuscles from rabbits, and also to the varying efficacy of the different human sera. The average percentages of results on both sides, however, clearly tend to prove *that the hæmolytic power of sera from drinkers was weaker than that from abstainers.*

TABLE VII.—DRINKERS.

1 c.c. of 5 per Cent. Suspension of Blood-Corpuscles from Rabbits.

Number of Person.	Quantity of Human Blood-Serum.—Percentage of Hæmolysis.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0 01	0·008	0·006	0·004
96	60	30	5	4	2·5	1	?	—	—	—	—
97	100	100	35	20	15	5	1	2	—	—	—
98	90	80	70	65	15	5	2·5	1	?	—	—
99	100	100	80	60	20	15	2·5	2	—	—	—
100	100	100	55	25	7·5	2·5	?	—	—	—	—
101	55	25	12	2·5	1	1	—	—	—	—	—
102	90	80	15	15	15	5	1	1	1	1	1
103	70	40	14	10	3	2·5	1	1	1	1	1
104	85	80	55	30	12	3	1	1	1	1	1
105	80	50	20	5	4	2	2	1	1	1	1
106	70	50	30	10	8	4	2	1	1	1	1
107	80	60	32	20	20	6	2·5	2·5	2·5	2·5	2·5
108	90	80	55	40	30	10	3	2·5	2·5	2·5	2·5
109	70	55	30	20	17	5	2·5	1·5	1·5	1	1
110	60	60	45	30	20	10	2·5	1	1	1	1
111	50	35	30	20	10	3	1	3	1	2·5	2·5
112	100	80	40	25	15	2·5	1	1	1	1	1
113	75	50	25	20	10	5	1	1	1	1	1
114	90	70	30	18	10	4	1	—	—	—	1
115	95	75	34	25	13	4	1	—	—	—	—
116	70	50	30	27	15	2·5	1	1	1	1	1
117	95	80	30	27	13	3	1	1	1	1	1
118	50	40	20	15	12	10	5	5	—	—	—
119	90	65	35	20	12	10	7	7	7	7	7
120	100	80	40	30	30	10	1	1	1	1	1
121	75	70	65	60	55	35	3	2·5	2·5	—	—
122	80	50	30	30	20	2·5	1	—	—	—	—
123	100	75	40	30	20	2·5	1	—	—	—	—
124	70	50	30	20	20	5	1	—	—	—	—
125	80	70	30	20	8	5	1	—	—	—	—
126	70	45	35	15	3	1	—	—	—	—	—
Average per-centage	80·32	63·71	35·42	24·47	14·71	5·87	1·63	1·29	0·90	0·09	0·09

TABLE VIII.—ABSTAINERS.

1 c.c. of 5 per Cent. Suspension of Blood-Corpuscles from Rabbits.

Number of Person.	Quantity of Human Blood-Serum.—Percentage of Hæmolysis.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0 01	0·008	0·006	0·004
127	75	45	7·5	5	5	2·5	1	?	—	—	—
128	90	80	70	55	40	5	1	—	—	—	—
129	85	80	70	50	35	7·5	2·5	?	—	—	—
130	85	80	70	55	15	10	5	2·5	?	—	—
131	100	100	35	10	5	5	2·5	2·5	1	—	—
132	100	100	85	25	40	5	7·5	2·5	1	—	—
133	95	85	70	40	15	2·5	—	?	—	—	—
134	85	70	60	25	20	10	5	2·5	—	—	—
135	100	100	100	100	100	20	10	2	—	—	—
136	100	100	70	65	20	7·5	1	?	—	—	—
137	95	90	30	20	8	2·5	1	1	—	—	—
138	100	90	70	70	30	4	1	1	1	1	1
139	90	55	25	20	10	3	1	1	1	2	1
140	70	60	30	20	18	15	10	1	1	1	1
141	100	100	80	70	40	10	2·5	1	1	1	1
142	85	75	20	20	8	3·5	2·5	1	1	1	1
143	40	20	20	20	10	2·5	1	2	1	1	1
144	85	70	40	30	20	10	2	1	1	1	1
145	90	70	40	25	10	3	2·5	2·5	2	2	2
146	60	40	27	15	5	2·5	1	1	1	1	1
147	50	35	20	15	10	5	1	1	1	1	1
148	60	15	8	7	4	1	—	—	—	—	—
149	100	70	40	30	13	10	10	10	8	8	8
150	100	50	20	20	15	5	1	1	1	1	1
151	60	55	30	20	10	2·5	2	1	1	1	1
152	50	50	35	25	10	2·5	2·5	1	1	1	1
153	60	50	30	15	5	2·5	1	1	—	—	—
154	60	40	20	5	7	2	1	1	1	1	—
155	60	50	20	12	5	2·5	1	1	1	—	—
156	95	90	70	55	30	5	2·5	—	—	—	—
157	100	80	35	25	13	4	1	—	—	—	—
158	100	100	80	50	15	2·5	1	—	—	—	—
159	85	75	70	60	40	5	1	—	—	—	—
160	95	70	35	25	5	2·5	1	—	—	—	—
161	75	60	70	55	30	2·5	1	—	—	—	—
Average percentage	82·29	68·57	45·79	33·12	19·03	5·33	2·49	1·19	0·71	0·69	0·63

TABLE IX.—BEFORE ALCOHOL DRINKING.

1 c.c. of 10 per Cent. Suspension of Blood-Corpuscles from Rabbits.

Number of Person.	Quantity of Human Blood-Serum.—Percentage of Hæmolysis.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
55	90	80	70	55	40	5	2	—	—	—	—
56	85	80	75	50	35	7·5	2·5	1	—	—	—
57	85	80	70	55	15	10	5	2·5	—	—	—
58	100	90	35	10	5	5	2·5	2·5	—	—	—
59	100	100	85	25	40	5	7·5	2·5	—	—	—
60	75	55	35	20	25	13	7	5	—	—	—
Average percentage	89·17	80·83	61·67	35·83	26·67	7·58	4·42	2·25	—	—	—

AFTER ALCOHOL DRINKING.

Number of Person.	Quantity of Human Blood-Serum.—Percentage of Hæmolysis.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
55	90	50	20	11	6	2·5	1·5	1·5	—	—	—
56	85	70	40	30	20	10	2	1	—	—	—
57	40	20	20	20	10	2·5	1	2	—	—	—
58	90	50	20	11	6	2·5	1·5	1·5	—	—	—
59	70	60	30	20	18	15	10	1	—	—	—
60	100	100	80	70	40	10	2·5	1	—	—	—
Average percentage	79·17	58·33	35·00	27·00	16·67	7·08	3·08	1·33	—	—	—

TABLE X.

1 c.c. of 5 per Cent. Suspension of Blood-Corpuscles from Rabbits

Description and Number of Person.	Quantity of Human Blood-Serum.—Percentage of Hæmolysis.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
Abstainer 93	85	75	70	60	40	5	2	1	—	—	—
Moderate 94	90	50	30	20	20	5	1	—	1	1	—
Drinker 95	80	70	30	20	8	5	1	—	—	—	—

The experiments given in Table IX. are very interesting, because they were made upon total abstainers, the resisting power of whose red blood-corpuscles was also examined as before described. The subjects were mostly women of whom I knew something. Some of them were well known to me, both before they had taken any alcohol and also after they had drunk alcohol daily for sixty-three days in quantities of 8 to 10 c.cm. in the form of wine containing 10 per cent. of alcohol. We find in the above cases, strange to say, that the smallest quantity of alcohol was able to cause a diminution in the hæmolytic power of their blood-serum.

Of great interest is the experiment the results of which are set forth in Table X. It has reference to three persons well known to me, all above fifty years of age—one an *abstainer*, one a *moderate* and one a *veritable drinker*. We find here, too, that the normal hæmolytic power of their respective blood-sera are somewhat different, in that the hæmolytic power of the blood-serum from the abstainer is greater than that from the moderate drinker, and strikingly greater than that from the heavy drinker. As mentioned earlier (Table VI.), the resistivity of their blood-corpuscles was also altered in the same manner.

We next come—

(*B*) TO THE INFLUENCE OF ALCOHOL UPON THE PRECIPITATING POWER OF HUMAN BLOOD-SERUM.

To find out if the precipitating power of the human blood-serum can be influenced by the consumption of alcohol, I made experiments, the results of which are indicated in Tables XI. and XII. The experiments were as follows: I took a dilution of 1 per cent. of fresh rabbit's serum in isotonic salt solution, and let human blood-serum operate upon it at a temperature of +37° C. for two hours. The greater part of my research to determine the precipitating power of blood-serum from drinkers and abstainers was conducted as in Tables XI. to XIV.

To a dilution of 1 per cent. human blood-serum were added different quantities—from 0·1 to 0·004 c.cm. (See Tables XIII. and XIV.) in all experiments—of the same blood-serum from rabbits immunized with human blood-serum. In all these experiments I was most careful to have the liquids perfectly clear before putting them together, so as to insure the greatest possible certainty of arriving at a true estimate of the reaction between the

TABLE XI.—DRINKERS.

1 c.c. of 1 per Cent. Rabbit Serum.

Number of Person.	Quantity of Human Blood Serum.—Degree of Precipitation.										
	0·4	0·2	0·1	0 08	0·06	0·04	0·02	0 01	0·008	0·006	0·004
96	+?	—	—	—	—	—	—	—	—	—	—
97	+	+?	—	—	—	—	—	—	—	—	—
98	+?	—	—	—	—	—	—	—	—	—	—
99	+?	?	—	—	—	—	—	—	—	—	—
100	?	—	—	—	—	—	—	—	—	—	—
	4	1	0	0	0	0	0	0	0	0	0
Average percentage	80	20	0	0	0	0	0	0	0	0	0

TABLE XII.—ABSTAINERS.

1 c.c. of 1 per Cent. Rabbit Serum.

Number of Person.	Quantity of Human Blood Serum.—Degree of Precipitation.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
101	+	+	+	±	±	±	±	?	—	—	—
102	+	+	+	+	+	+	+	±	—	—	—
103	+	+	±	?	—	—	—	—	—	—	—
104	+	+	?	—	—	—	—	—	—	—	—
105	+	?	—	—	—	—	—	—	—	—	—
106	+?	—	—	—	—	—	—	—	—	—	—
107	+	+	—	—	—	—	—	—	—	—	—
108	+	+?	—	—	—	—	—	—	—	—	—
109	+	+	+?	—	—	—	—	—	—	—	—
110	+	+	+?	—	—	—	—	—	—	—	—
111	+	+	±	±	?	—	—	—	—	—	—
112	+	+	±	?	—	—	—	—	—	—	—
113	+	+	?	—	—	—	—	—	—	—	—
	13	11	7	3	2	2	2	1	0	0	0
Average percentage	100	84·62	53·85	23·08	15·38	15·38	15·38	7·69	0	0	0

TABLE XIII.—DRINKERS.

1 c.c. of 1 per Cent. Human Blood Serum.

Number of Person.	Quantity of (Rabbit) Immune Serum.—Degree of Precipitation.								
	0·1	0·08	0 06	0·04	0·02	0·01	0 008	0·006	0·004
114	+	+	+	+	±	—	—	—	—
115	+	+	+	+	+	±	?	—	—
116	+	+	+	+	±	±	?	?	?
117	+	+	+	+	+	±	?	—	—
118	+	+	+	+	+	?	—	—	—
119	+	+	+	+	±	—?	—	—	—
120	+	+	+	+	+	±	?	+	—
121	+	+	+	+	±	?	?	—	—
122	+	+	+	+	?	±	—	—	—
123	+	+	+	+	∓	—	—	—	—
124	+	+	+	+	I+	?	±	—	—
125	+	+	+	+	+	±	±	?	—
126	+	+	+	±	?	—	—	—	—
127	+	+	+	±	+	?	—	—	—
128	+	+	+	+	±	?	—	—	—
129	+	+	+	+	+	±	?	—	—
130	+	+	+	+	+	+	+	+	±
131	+	+	+	+	+	+	+	+	±
132	+	+	+	+	+	±	?	—	—
133	+	+	+	±	±	?	—	—	—
134	+	+	+	+	±	?	?	—	?
135	+	+	+	±	?	—	—	—	—
136	+	+	+	+	±	—	—	—	—
137	+	+	+	±	?	—	—	—	—
138	+	+	+	+	±	—	—	—	—
139	+	+	+	+	+	±	?	±	—
	26	26	26	26	22	11	4	4	2
Average percentage	100	100	100	100	84·62	42·31	15·38	15·38	7·62

TABLE XIV.—ABSTAINERS.

1 c.c. of 1 per Cent. Human Serum.

Number of Person.	Quantity of (Rabbit) Immune Serum.—Degree of Precipitation.								
	0·1	0·08	0·06	0·04	0 02	0·01	0·008	0·006	0·004
140	+	+	+	+	?	—	—	—	—
141	+	+	±	—	—	—	—	—	—
142	+	+	+	+	±	?	—	—	—
143	+	+	+	+	±	?	—	—	—
144	+	+	+	+	?	—	—	—	—
145	+	+	+	+	?	—	—	—	—
146	+	+	+	+	?	—	—	—	—
147	+	+	+	+	?	—	—	—	—
148	+	+	±	±	?	—	—	—	—
149	+	+	+	+	±	?	—	—	—
150	+	+	+	?	—	—	—	—	—
151	+	+	+	+	+	+	+	+	±
152	+	+	+	+	±	—	—	—	—
153	+	+	+	+	?	—	—	—	—
154	+	+	+	+	±	—	—	—	—
155	+	+	+	±	±	—	—	—	—
156	+	+	+	±	±	—	—	—	—
157	+	+	+	±	?	—	—	—	—
158	+	+	+	+	—	—	—	—	—
159	+	+	+	±	?	—	—	—	—
160	±	± ?	—	—	—	—	—	—	—
161	+	+	+	—	—	—	—	—	—
162	+	+	+	± ?	—	—	—	—	—
163	±	?	—	—	—	—	—	—	—
	24	23	22	19	8	1	1	1	1
Average percentage	100	95·83	91·67	79·17	33·33	4·33	4·33	4·33	4·33

two liquids, to which end also I have used all available means, including the *ultra-microscope*. But in spite of this, the task of estimation, I must confess, has been exceedingly difficult, as may be inferred from the many notes of interrogation to be found on the respective tables. Moreover, the results are also difficult to explain theoretically, and for these explanations I have neither time nor space in this lecture. I only assert that, if I put to a dilution of 1 per cent. of the same rabbit's serum different quantities of blood-serum from drinkers and abstainers, the reaction resulting from the action of serum from drinkers was less than in the case of abstainers. These experiments were but few, and the numbers in the two classes too unequal to allow of very great stress being laid on the results. I maintain further that, if I put to a solution of 1 per cent. of human blood-serum different quantities of serum from rabbits immunized by human blood-serum, *the reaction between the same immune serum and sera from drinkers was clearly less than that between the same immune serum and sera from abstainers, as shown also in the average percentages in Tables XIII. and XIV.*

Reflecting upon these facts, especially the last-named, I am inclined to assert that the greater reaction of precipitation signifies a deterioration of human blood-serum caused by consumption of alcohol. It signifies, at least, that it has been influenced by alcohol.

With regard to the experiments referred to under the headings (*A*) and (*B*), relating to the influence of alcohol upon human blood-serum, we see *that the hæmolytic power of blood-serum from drinkers was diminished in comparison with blood-serum from abstainers; but the precipitation reaction, on the contrary, was greater between the weaker (?) serum from drinkers and the immune serum than between the stronger (?) serum from abstainers and immune serum.*

In the third place we must consider

THE DETERMINATION OF THE HÆMOLYTIC COMPLEMENT OF HUMAN BLOOD UNDER THE INFLUENCE OF ALCOHOL.

As previously mentioned, Abbot and Bergey showed as early as 1902 that the hæmolytic complement was diminished by the action of alcohol upon rabbit's serum. In my experiments I have endeavoured to discover whether alcohol altered the complement in human serum. To obtain the amboceptor serum necessary

for this purpose I immunized sheep with human red blood-corpuscles, washed thrice in an isotonic solution of salt. The immunity in these animals was so high that about 0·06 c.cm. was enough to dissolve the red blood-corpuscles contained in 1 c.cm. of a suspension of 5 per cent. of the corpuscles in an isotonic salt solution. In all the experiments referred to here the same immune serum (from sheep), incubated at +56° C. for one hour, was used.

The further details of the experiment were these: To 1 c.cm. of the suspension above mentioned was added 0·1 c.cm. of the amboceptor serum. These were thoroughly mixed and kept at a temperature of +37° C. for half-an-hour. Afterwards I again washed the corpuscles twice in an isotonic solution of salt by centrifugalization to insure that any part of the amboceptor serum which might possibly not have been fixed by the red blood-corpuscles should not influence the final reaction, and that only amboceptor fixed by the corpuscles should be made active by the complement, so that the complement power of the serum to be examined should be very clearly observed. The degree of the complement varied, as shown by the tables, from 0·4 to 0·0004. And, lastly, the amount of isotonic solution of salt that was required in order that every test-tube should contain the total of 2 c.cm., was added. Then the contents of these test-tubes were thoroughly blended by means of a glass "mixer" specially constructed for that purpose. The tubes were now again subjected to a temperature of +37° C. for two hours, and were afterwards placed in a refrigerator for from eighteen to twenty hours; and then the degree of hæmolysis in every tube was compared with the corresponding scale, made by dissolving the red blood-corpuscles contained in 1 c.cm. of blood in so much water that the corpuscles and water together made exactly 40 c.cm. (corresponding to a suspension of 2·5 per cent. of blood), in order to get the same dilution of hæmoglobin as in the tubes under experiment, should total hæmolysis take place [1 c.cm. suspension of 5 per cent. diluted with the different liquids to 2 c.cm. = 2·5 per cent.] The total hæmolysis in the tubes under experiment, as well as the water suspension of red blood-corpuscles, should correspond to 100 per cent. in our scale. By diluting the water suspension of blood-corpuscles with salt solution—bearing in mind that in every test-tube in the scale there must be 2 c.cm., as in the experiment tubes—I made the scale in other respects as before mentioned.

TABLE XV.

Description and Number of Person.	Quantity of Human Complement.—Percentage of Hæmolysis.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 164	90	90	65	55	50	35	20	15	8	7·5	4	1	1	1	1	1
165	85	80	47	50	35	25	15	10	7·5	5	3	2	2	2	2	1
Drinker 166	50	50	35	33	25	10	8	4	3	2·5	2	1	1	1	1	0·5

TABLE XVI.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainers 167	90	75	65	80	55	55	27	13	10	7·5	5	3	2	3·5	2·5	2
168	100	80	80	80	65	45	30	30	15	10	7·5	3	2	2	1	1
Drinker 169	80	75	60	55	50	35	22	15	7·5	7·5	3·5	3	2	2	2	1

TABLE XVII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 170	50	55	40	40	40	25	15	10	10	7·5	5	5	3	4	4	4
171	100	—	80	—	35	—	25	—	17	—	10	—	5	—	4	—
Drinker 172	80	70	30	40	37	20	15	7·5	7·5	5	4	3	2	2	2	2
173	60	—	40	—	35	—	22	—	—	—	—	—	—	—	—	—

TABLE XVIII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 174	7·5	3	2	2	1	0·5	0·5	—	—	—	—	—	1	1	—	1
175	25	10	5	5	3	2	1	2	0·5	0·5	1	—	2	2	2·5	0·5
Drinker 176	33	25	15	10	10	10	5	2·5	1	1	3	2·5	2·5	2·5	5	0·5
177	85	85	65	80	80	55	20	15	5	2·5	1	0·5	0·5	0·5	0·5	1

TABLE XIX.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 178	65	70	55	40	25	20	15	10	2·5	2·5	1	1	2	2	2·5	1·5
Drinker 179	95	95	70	70	60	40	0·5	15	10	5	2·5	1	0·5	—	2	—
180	60	30	40	35	20	15	7·5	2·5	2	1·5	2·5	1	1	1	1	0·5

TABLE XX.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 181	90	77	63	50	30	30	30	7·5	5	2·5	2	0·5	0·5	1	1	0·5
Drinker 182	37	50	40	30	20	15	5	3	2	1	0·5	0·5	0·5	3	0·5	2
183	95	80	80	75	63	60	25	5	3	5	1	1	1	1	2	2

TABLE XXI.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 184	65	60	30	27	15	7·5	3·5	3	1	1	1	1	5	7·5	2·5	2
185	100	85	70	35	30	15	10	3·5	2·5	2	1	4	2	3	1	5
Drinker 186	75	65	45	40	30	15	10	3	1	2	2	2	3	2	2	2
187	70	60	60	50	40	27	10	5	2·5	1	0·5	0·5	2	2	2·5	2·5

TABLE XXII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 188	95	95	50	35	25	12	7·5	5	2·5	1·5	1·5	1	0·5	1·5	0·5	0·5
189	100	65	30	25	12	10	7·5	4	2	1·5	1	2	0·5	1	5	0·5
Drinker 190	100	95	90	85	80	55	30	15	7·5	5	1	—	5	2	2·5	0·5
191	97	97	95	60	50	30	10	8·5	5	1·5	1	0·5	0·5	—	—	1

TABLE XXIII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 192	75	75	70	70	60	45	25	17	10	5	5	5	2·5	2·5	2	2
193	90	95	90	90	90	85	45		24	12	6	2·5	4	5	1	1
Drinker 194	100	100	80	90	75	65	28	15	10	6	4	2·5	1	1	2	5
195	100	80	85	80	75	60	42	35	27	17	10	2	5	2·5	2·5	1·5

TABLE XXIV.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0 2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 196	90	60	47	45	25	20	15	7	5	2	1	1	1	1·5	1	1
197	90	95	60	35	25	13	5	3	2	1	0·5	1	1	0·5	1	1
Drinker 198	95	90	75	75	45	35	13	13	5	3	1	1	1	1	1	1
199	85	90	85	75	50	45	22	7·5	5	1	1	0·5	1	0·5	1	1

TABLE XXV.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 200	67	42	16	14	7·5	4	4	1	—	—	—	—	—	—	—	—
201	20	25	15	14	7·5	4	2·5	1·5	1	—	—	—	—	—	—	—
Drinker 202	90	34	40	35	25	10	5	2·5	1·5	1	0·5	—	—	—	—	0·5
203	70	30	17	12	8·5	5	5	1	1	0·5	0·5	0·5	—	0·5	0·5	—

TABLE XXVI.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 204	90	75	65	60	44	30	15	10	5	1	1	1	2	10	7	2·5
205	85	55	58	57	43	48	20	7	5	3	3	1	1	2	4	10
Drinker 206	85	80	65	45	43	43	10	6	5	2·5	1·5	1	2	7·5	7·5	1·5
207	100	90	70	60	44	35	17	20	10	10	1·5	1	1	1	0·5	1

TABLE XXVII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 208	55	50	30	25	15	7·5	5	3	2	1	0·5	0·5	—	—	—	—
Drinker 209	75	50	18	12	10	7·5	3	2	1·5	1	0·5	—	—	—	—	—
210	75	60	25	15	10	6	2·5	1·5	1·5	0·5	—	—	—	—	—	—
211	50	45	30	25	12	6	3	2	1·5	0·5	0·5	—	0·5	—	1	—
212	75	50	25	18	10	6	2	1	0·5	0·5	0·5	1	—	—	—	—

TABLE XXVIII.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 213	85	70	30	25	15	7	5	1·5	1	1	0·5	1	—	1	2	—
Drinker 214	100	85	55	40	45	17	6·5	4	5	2	1	—	0·5	0·5	1	0·5
215	85	70	30	20	15	6·5	5	1	1	1	0·5	1	2	1	0·5	0·5
216	100	65	40	30	20	6	5	2	1·5	1	1	1	1·5	1·	0·5	1

TABLE XXIX.

Description and Number of Person.	Quantity of Human Complement.															
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004
Abstainer 217	50	35	20	20	15	7·5	5	0·5	—	—	—	—	—	—	—	—
218	17	15	15	8	10	2	2·5	1	1	3	2	1	5	2·5	2	—
219	40	25	7·5	10	10	5	3	2	1	—	—	2	—	—	—	—
Drinker 220	55	40	27	30	25	7·5	2·5	1·5	1	—	—	—	—	—	—	—
221	70	50	35		25	20	3	0·5	0·5	0·5	5	—	—	—	—	2
222	70	35	25	25	22	10	4	2	2	1·5	—	—	0·5	—	—	—
223	70	45	20	25	15	12	3	1	0·5	—	—	—	—	—	—	—

If we look at the different experiments made in the manner just described, and shown in Tables XV. to XXIX., we find that the complement action of blood-serum from different persons was very varied, although the immune serum used in these experi, ments was the same, and only the resistivity of red blood corpuscles (in every experiment from a different person) and the complement action differed. But if we take the average percentages of the experiments (Tables XXX. and XXXI.), we find that the complement from drinkers is shown to be greater—more active in the lower dilutions (0·4 to 0·04) and less active in higher dilutions (0·02 to 0·0004). It is possible that the greater activity in the lower dilutions is to some extent only apparent, owing to the fact that the complement action of serum from women, who were in the last-named experiments mostly abstainers, in lower dilutions is noticeably less than is the complement action of serum from the men (see Tables XXXII. and XXXIII.), whilst in higher dilutions it is greater than that of men. This has been the case to some very small extent in the resistivity of the red blood-corpuscles from both sexes, and in the hæmolytic power of blood-serum from them both; but in these experiments the women have been more evenly divided on both sides. The average age in this series of experiments, as also in the earlier series, was nearly the same. Besides this, the hæmolysis in these different experiments may possibly depend, in a minor degree, upon the quantity of alcohol which may be present in the blood itself taken from drinkers, if the experiments were made a short time after the drinking of alcohol. We can see in Table XXXIV., which shows its direct influence upon hæmolysis, that alcohol as such, may have an influence—as a hæmolytic poison—upon this reaction; and I must confess that a number of persons in the last experiments were intoxicated when the blood was drawn. It is naturally better to draw the blood, as I usually did, thirty-six to forty-eight hours after alcohol was last consumed.

In any case, I cannot deny that the average complement-content of blood-serum from the remarkable number of persons used in my experiments was greater in the majority of the different dilutions in the case of abstainers than in that of drinkers. But the influence of the consumption of alcohol upon the complement of human serum was not at all remarkable, because the complement action of the serum from women, which may here play any rôle, was greater in the higher dilutions.

TABLE XXX.—DRINKERS.

1 c.c. of 5 per Cent. Solution of Human Red Blood-Corpuscles and 0·1 c.c. of Immune Serum.

Number of Person.	Quantity of Human Complement.—Percentage of Hæmolysis.															Age of Person.
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004	
	50	50	35	33	25	10	8	4	3	2·5	2	1	1	1	1	0·5	46
	80	75	60	55	50	35	22	15	7·5	7·5	3·5	3	2	2	2	1	31
	80	70	30	40	37	20	15	7·5	7·5	5	4	3	2	2	2	2	32
	60	—	40	—	35	—	22	—	—	—	—	—	—	—	—	—	63
	33	25	15	10	10	10	5	2·5	1	1	3	2·5	2·5	2·5	5	0·5	23
	85	85	65	80	80	55	20	15	5	2·5	1	0·5	0·5	0·5	0·5	1	34
	95	95	70	70	60	40	0·5	15	10	5	2·5	1	0·5	—	2	—	54
	60	30	40	35	20	15	7·5	2·5	2	1·5	2·5	1	1	1	1	0·5	30
	37	50	40	30	20	15	5	3	2	1	0·5	0·5	0·5	3	0·5	2	26
	95	80	80	75	63	60	25	5	3	5	1	1	1	1	2	2	43
	75	65	45	40	30	15	10	3	1	2	2	2	3	2	2	2	41
	70	60	60	50	40	27	10	5	2·5	1	0·5	0·5	2	2	2 5	2·5	29

	100	95	90	85	80	55	30	15	7·5	5	1	—	5	2	2·5	0·5	30
	97	97	95	60	50	30	10	8·5	5	1·5	1	0·5	0·5	—	—	1	19
	100	100	80	90	75	65	28	15	10	6	4	2·5	1	1	2	5	45
	100	80	85	80	75	60	42	35	27	17	10	2	5	2·5	2·5	1·5	46
	95	90	75	75	45	35	13	13	5	3	1	1	1	1	1	1	33
	85	90	85	75	50	45	22	7·5	5	1	1	0·5	1	0·5	1	1	29
	90	34	40	35	25	10	5	2·5	1·5	1	0·5	—	—	—	—	0·5	44
	70	30	17	12	8·5	5	5	1	1	0·5	0·5	0·5	—	0·5	0·5	—	30
	85	80	65	45	43	43	10	6	5	2·5	1·5	1	2	7·5	7 5	1·5	20
	100	90	70	60	44	35	17	20	10	10	1·5	1	1	1	0·5	1	23
	75	50	18	12	10	7·5	3	2	1·5	1	0·5	—	—	—	—	—	24
	75	60	25	15	10	6	2·5	1·5	1·5	0·5	—	—	—	—	—	—	30
	50	45	30	25	12	6	3	2	1·5	0·5	0·5	—	0·5	—	1	—	26
	75	50	25	18	10	6	2	1	0·5	0·5	0·5	1	—	—	—	—	26
	100	85	55	40	45	17	6·5	4	5	2	1	—	0·5	0·5	1	0·5	23
	85	70	30	20	15	6·5	5	1	1	1	0·5	1	2	1	0·5	0·5	27
	100	65	40	30	20	6	5	2	1·5	1	1	1	1·5	1	0·5	1	24
	55	40	27	30	25	7·5	2·5	1·5	1	—	—	—	—	—	—	—	34
	70	50	35	—	25	20	3	0·5	0·5	0·5	5	—	—	—	—	2	28
	70	35	25	25	22	10	4	2	2	1·5	—	—	0·5	—	—	—	33
	70	45	20	25	15	12	3	1	0·5	—	—	—	—	—	—	—	26
Average percentage	77·79	64·56	48·85	44·35	35·59	24·67	11·26	6·86	4·31	2·81	1·67	0·88	1·17	1·11	1·28	0·97	Av. Age 32·48

TABLE XXXI.—ABSTAINERS.

1 c.c. of 5 per Cent. Solution of Human Red Blood-Corpuscles and 0·1 c.c. of Immune Serum.

Number of Person.	Quantity of Human Complement.—Percentage of Hæmolysis.															Age of Person.
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004	
	90	90	65	55	50	35	20	15	8	7·5	4	1	1	1	1	1	21
	85	80	47	50	35	25	15	10	7·5	5	3	2	2	2	2	1	37
	90	75	65	80	55	55	27	13	10	7·5	5	3	2	3·5	2·5	2	21
	100	80	80	80	65	45	30	30	15	10	7·5	3	2	2	1	1	20
	50	55	40	40	40	25	15	10	10	7·5	5	5	3	4	4	4	29
	100	—	80	—	35	—	25	—	17	—	10	—	5	—	4	—	36
	7·5	3	2	2	1	0·5	0·5	—	—	—	—	—	1	1	—	1	26
	25	10	5	5	3	2	1	2	0·5	0·5	1	—	2	2	2 5	0·5	26
	65	70	55	40	25	20	15	10	2·5	2·5	1	1	2	2	2·5	1·5	30
	90	77	63	50	30	30	30	7·5	5	2·5	2	0·5	0·5	1	1	0·5	22
	65	60	30	27	15	7·5	3·5	3	1	1	1	1	5	7·5	2·5	2	18
	100	85	70	35	30	15	10	3·5	2·5	2	1	4	2	3	1	5	18
	95	95	50	35	25	12	7·5	5	2·5	1·5	1·5	1	0·5	1·5	0·5	0·5	43
	100	65	30	25	12	10	7·5	4	2	1·5	1	2	0·5	1	5	0·5	43
	75	75	70	70	60	45	25	17	10	5	5	5	2·5	2·5	2	2	17
	90	95	90	90	90	85	45	25	24	12	6	2·5	4	5	1	1	17
	90	60	47	45	25	20	15	7	5	2	1	1	1	1·5	1	1	23
	90	95	60	35	25	13	5	3	2	1	0·5	1	1	0·5	1	1	23
	67	42	16	14	7·5	4	4	1	—	—	—	—	—	—	—	—	33
	20	25	15	14	7·5	4	2·5	1·5	1	—	—	—	—	—	—	—	33
	90	75	65	60	44	30	15	10	5	1	1	1	2	10	7	2·5	32
	85	55	58	57	43	48	20	7	5	3	3	1	1	2	4	10	32
	55	50	30	25	15	7·5	5	3	2	1	0·5	0·5	—	—	—	—	39
	85	70	30	25	15	7	5	1·5	1	1	0·5	1	—	1	2	—	30
	17	15	15	8	10	2	2·5	1	1	3	2	1	5	2·5	2	—	38
	50	35	20	20	15	7·5	5	0·5	—	—	—	—	—	—	—	—	19
	40	2·5	7·5	10	10	5	3	2	1	—	—	2	—	—	—	—	40
Average percentage	70·98	59·21	44·65	38·35	29·19	21·54	13·30	7·40	5·20	3·00	2·31	1·52	1·67	2·17	1·83	1·46	Av. Age 28·37

TABLE XXXII.—WOMEN.

1 c.c. of 5 per Cent. Solution of Human Red Blood-Corpuscles and 0·1 c.c. of Immune Serum.

Number of Person.	Quantity of Human Complement.																Age of Person.
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004	
	85	80	47	50	35	25	15	10	7·5	5	3	2	2	2	2	1	37
	100	80	80	80	65	45	30	30	15	10	7·5	3	2	2	1	1	20
	50	55	40	40	40	25	15	10	10	7·5	5	5	3	4	4	4	29
	75	75	70	70	60	45	25	17	10	5	5	5	2·5	2·5	2	2	17
	90	95	90	90	90	85	45	25	24	12	6	2·5	4	5	1	1	17
	90	60	47	45	25	20	15	7	5	2	1	1	1	1·5	1	1	23
	90	95	60	35	25	13	5	3	2	1	0·5	1	1	0·5	1	1	23
	67	42	16	14	7·5	4	4	1	—	—	—	—	—	—	—	—	33
	20	25	15	14	7·5	4	2·5	1·5	1	—	—	—	—	—	—	—	33
	90	75	65	60	44	30	15	10	5	1	1	1	2	10	7	2·5	32
	85	55	58	57	43	48	20	7	5	3	3	1	1	2	4	10	32
	85	70	30	25	15	7	5	1·5	1	1	0·5	1	—	1	2	—	30
	17	15	15	8	10	2	2·5	1	1	3	2	1	5	2·5	2	—	38
	50	35	20	20	15	7·5	5	0·5	—	—	—	—	—	—	—	—	19
	40	2·5	7·5	10	10	5	3	2	1	—	—	2	—	—	—	—	40
Average percentage	68·93	57·30	44·03	41·20	32·80	24·37	13·80	8·43	5·83	3·37	2·30	1·70	1·57	2·20	1·80	1·57	Av. Age 28·20

TABLE XXXIII.—MEN.

1 c.c. of 5 per Cent. Solution of Human Red Blood-Corpuscles and 0·1 c.c. of Immune Serum.

Number of Person.	Quantity of Human Complement.																Age of Person.
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004	0·002	0·001	0·0008	0·0006	0·0004	
	90	90	65	55	50	35	20	15	8	7·5	4	1	1	1	1	1	21
	50	50	35	33	25	10	8	4	3	2·5	2	1	1	1	1	0·5	46
	90	75	65	80	55	55	27	13	10	7·5	5	3	2	3·5	2·5	2	21
	80	75	60	55	50	35	22	15	7·5	7·5	3·5	3	2	2	2	1	31
	100	—	80	—	35	—	25	—	17	—	10	—	5	—	4	—	36
	60	—	40	—	35	—	22	—	—	—	—	—	—	—	—	—	63
	80	70	30	40	37	20	15	7·5	7·5	5	4	3	2	2	2	2	32
	7·5	3	2	2	1	0·5	0·5	—	—	—	—	—	1	1	—	1	26
	25	10	5	5	3	2	1	2	0·5	0·5	1	—	2	2	2·5	0·5	26
	33	25	15	10	10	10	5	2·5	1	1	3	2·5	2·5	2·5	5	0·5	23
	85	85	65	80	80	55	20	15	5	2·5	1	0·5	0·5	0·5	0·5	1	34
	65	70	55	40	25	20	15	10	2·5	2·5	1	1	2	2	2·5	1·5	30
	95	95	70	70	60	40	0·5	15	10	5	2·5	1	0·5	—	2	—	54
	60	30	40	35	20	15	7·5	2·5	2	1·5	2·5	1	1	1	1	0·5	30
	90	77	63	50	30	30	30	7·5	5	2·5	2	0·5	0·5	1	1	0·5	22
	37	50	40	30	20	15	5	3	2	1	0·5	0·5	0·5	3	0·5	2	26
	95	80	80	75	63	60	25	5	3	5	1	1	1	1	2	2	43
	65	60	30	27	15	7·5	3·5	3	1	1	1	1	5	7·5	2·5	2	18
	100	85	70	35	30	15	10	3·5	2·5	2	1	4	2	3	1	5	18

75	65	45	40	30	15	10	3	1	2	2	2	3	2	2	2	41
70	60	60	50	40	27	10	5	2·5	1	0·5	0·5	2	2	2·5	2·5	29
95	95	50	35	25	12	7·5	5	2·5	1·5	1·5	1	0·5	1·5	0·5	0·5	43
100	65	30	25	12	10	7·5	4	2	1·5	1	2	0·5	1	5	0·5	43
100	95	90	85	80	55	30	15	7·5	5	1	—	5	2	2·5	0·5	30
97	97	95	60	50	30	10	8·5	5	1·5	1	0·5	0·5	—	—	1	19
100	100	80	90	75	65	28	15	10	6	4	2·5	1	1	2	5	45
100	80	85	80	75	60	42	35	27	17	10	2	5	2·5	2·5	1·5	46
95	90	75	75	45	35	13	13	5	3	1	1	1	1	1	1	33
85	90	85	75	50	45	22	7·5	5	1	1	0·5	1	0·5	1	1	29
90	34	40	35	25	10	5	2·5	1·5	1	0·5	—	—	—	—	0·5	44
70	30	17	12	8·5	5	5	1	1	0·5	0·5	0·5	—	0·5	0·5	—	30
85	80	65	45	43	43	10	6	5	2·5	1·5	1	2	7·5	7·5	1·5	20
100	90	70	60	44	35	17	20	10	10	1·5	1	1	1	0·5	1	23
55	50	30	25	15	7·5	5	3	2	1	0·5	0·5	—	—	—	—	39
75	50	18	12	10	7·5	3	2	1·5	1	0·5	—	—	—	—	—	24
75	60	25	15	10	6	2·5	1·5	1·5	0·5	—	—	—	—	—	—	30
50	45	30	25	12	6	3	2	1·5	0·5	0·5	—	0·5	—	1	—	26
75	50	25	18	10	6	2	1	0·5	0·5	0·5	1	—	—	—	—	26
100	85	55	40	45	17	6·5	4	5	2	1	—	0·5	0·5	1	0·5	23
85	70	30	20	15	6·5	5	1	1	1	0·5	1	2	1	0·5	0·5	27
100	65	40	30	20	6	5	2	1·5	1	1	1	1·5	1	0·5	1	24
55	40	27	30	25	7·5	2·5	1·5	1	—	—	—	—	—	—	—	34
70	50	35	—	25	20	3	0·5	0·5	0·5	5	—	—	—	—	2	28
70	35	25	25	22	10	4	2	2	1·5	—	—	0·5	—	—	—	33
70	45	20	25	15	12	3	1	0·5	—	—	—	—	—	—	—	26
Average percentage 76·66	63·86	47·93	41·76	32·68	22·88	11·63	6·64	4·34	2·73	1·85	0·98	1·34	1·37	1·44	1·06	Av. Age 31·44

TABLE XXXIV.

Showing the Direct Influence of Alcohol upon Hæmolysis: Average Percentages of Twelve Different Experiments.

	Quantity of the Hæmolytic Serum.										
	0·4	0·2	0·1	0·08	0·06	0·04	0·02	0·01	0·008	0·006	0·004
Hæmolysis without alcohol ..	57·38	34·23	20·73	16·38	8·38	3·85	0·54	0·19	—	0·15	—
Hæmolysis with 20 per cent. alcohol	75	75	52·5	55	62·5	62·5	65	60	55	70	65
Hæmolysis with 5 per cent. alcohol	63·18	46·45	32·95	29·36	19·77	11·91	2·55	0·45	0·09	0·14	0·36
Hæmolysis with 2 per cent. alcohol	47·50	40·50	36	33	15·50	2·50	0·75	0·75	0·75	0·75	0·75

We now come to

THE DETERMINATION OF THE BACTERICIDAL POWER OF BLOOD-SERUM FROM ALCOHOL-DRINKERS AND ABSTAINERS.

I stated in my lecture at the International Congress on Alcoholism at Stockholm that alcohol causes a slight diminution of the bactericidal power of blood-serum from animals tested. This has been contradicted by Dr. Leva, but he made his experiments in a manner totally different from mine.

In connection with the researches before described, I have now made a number of experiments to ascertain if human blood-serum can be affected by alcohol in this way. For that purpose, into 1 c.cm. of fresh blood-serum (the blood was drawn exactly the same length of time before the experiment from both drinkers and abstainers) I put the loop of the same platinum needle which had been dipped into a certain suspension of *Bacillus typhosus* (twenty-four hours old) into bouillon, and mixed it well. Then I put the test-tubes containing the serum-bacteria mixture into a thermostat at a temperature of 37° C. Afterwards, at the expiration of one, two, six, and twenty-four hours, by means of a normal platinum needle loop (0·002 milligramme), I laid gelatine cultures from the mixture in Petri's dishes, and carefully counted the bacteria colonies which grew during the five following days. The initial suspension of the typhoid organism in bouillon was, in the first few experiments, less concentrated than in the succeeding ones. Usually one abstainer and two drinkers were examined at the same time. The results of these experiments are seen in Tables XXXV. and XXXVI.

If we compare the average numbers of "typhoid" colonies (Tables XXXV. and XXXVI.) resulting from sowings at the various times, we find that in the case of drinkers the colonies are decidedly more numerous than in the case of abstainers. *The blood-serum from abstainers consequently was in these experiments more bactericidal than that from drinkers.*

The experiments on human beings in this direction were not very numerous, *but they seem to support the conclusions which I have previously drawn from tests upon animals.*

GENERAL CONCLUSIONS.

Having now given the facts and data relating to these researches, and having shortly touched upon their results, I will, in conclusion, only add that the consumption of alcohol exercises an

influence on human blood, and that this influence, according to these experiments, which relate to 223 human beings, partly alcohol-takers, partly abstainers, shows itself in the following ways :

1. The normal resistance of human red blood-corpuscles appears to be somewhat diminished against a heterogeneous normal serum, or an immune serum, by the consumption of alcohol, provided that tolerably large equal, or nearly equal, numbers of drinkers and abstainers of both sexes be examined, and the average of resistance be taken on both sides. This last precaution is

TABLE XXXV.—DRINKERS.

1 c.c. Human Blood-Serum + 1 Loop Bacillus Typhosus Mixture.

	Length of Time in Hours, after which the Cultures for Counting were Sown.			
	1 hour.	2 hours.	6 hours.	24 hours.
	1	0	5	0
	2	1	0	0
	7	0	1	0
	5	1	2	0
	5	0	0	10
	2	0	1	0
	80	16	2	4
	533	0	0	1
	264	0	41	1
	1,665	434	14	0
	2,120	551	3	3
	6,500	914	12	0
	4,648	1,389	1,065	12
	6,600	1,102	8	13
	6,300	501	26	0
	5,360	707	282	1
	1,199	6	2	1
	1,466	60	3	0
	1,183	50	3	2
	37,940	5,732	1,470	48
Average number of bacteria colonies	1996·84	337·18	77·37	2·67

TABLE XXXVI.—ABSTAINERS.

1 c.c. Human Blood-Serum + 1 Loop Bacillus Typhosus Mixture.

	Length of Time in Hours, after which the Cultures for Counting were Sown.			
	1 hour.	2 hours.	6 hours.	24 hours.
	2	0	0	1
	1	2	1	1
	4	0	2	0
	226	13	0	0
	—	289	112	3
	873	311	35	5
	7,100	1,201	4	3
	6,700	—	5	1
	1,442	112	5	0
	1,160	74	4	1
	1,079	82	1	1
	18,587	2,084	169	16
Average number of bacteria colonies	1858·7	208·4	15·37	1·45

necessary, because the power of resistance of red blood-corpuscles from different human beings varies largely. The difference is often greater when using weaker dilutions than when using stronger dilutions of lysin. [It would be well to take for the different series of tests persons of the same sex.]

2. The experiments have shown the normal hæmolytic power of human blood-serum to be less in the case of drinkers than in that of abstainers examined as just described.

3. The precipitative reaction between a solution of 1 per cent. human blood-serum and different dilutions of immune serum (obtained by immunizing with human blood-serum the animals to be tested) was greater in the case of drinkers than in that of abstainers.

4. The complement action of human blood-serum, according to these experiments, was greater in the stronger dilutions (0·4 to 0·04) and less in the weaker dilutions (0·02 to 0·0004) in the case of drinkers than in that of abstainers, *it was however not much affected.*

The higher degree of the complement action of blood-serum from drinkers in the stronger dilutions may, to a certain extent, be explained as mentioned earlier.

5. These experiments also showed that the bactericidal power of blood-serum against typhoid bacteria was less in the case of drinkers than in that of abstainers.

It is possible that alcohol causes chemically, physiologically, or anatomically, the diminution of resisting power in different parts —the blood not excepted—of the body in the case of different persons (*locus minoris resistentiæ* for alcohol).

These serological differences in the human blood, caused by consumption of alcohol, explain, at least partially, the diminution of the resisting power of the human body.

ABSTRACT OF PROFESSOR LAITINEN'S NORMAN KERR LECTURE ON "THE INFLUENCE OF ALCOHOL ON IMMUNITY."

I stated in a paper read at the last International Congress on Alcohol, held in Stockholm in 1907, that alcohol, even in small quantities, causes a diminution of resistance of red blood-corpuscles against a heterogeneous serum. I also then stated that I had begun a series of further investigations relating to the question as it concerned the human body. The result of these researches up to the present time I now present in this Norman Kerr Memorial Lecture. The persons experimented upon numbered 223, beginning with myself. They were of different classes and ages. There were medical professors and other physicians, University Fellows, students of both sexes, hospital nurses, school-teachers of both sexes, waiters, and other men and women of the working class. My studies have been directed to an investigation of the following points :

1. I sought to ascertain whether the resistance of human red blood-corpuscles against a heterogeneous normal serum or an immune serum can be diminished by the use of alcohol.

2. I have studied the action of alcohol in drinking and abstaining persons on the hæmolytic power of blood-serum over heterogeneous red blood-corpuscles (rabbits). I have studied not only the hæmolytic power of the human blood-serum, but also its power of precipitation in the presence of rabbit-serum, with a view to ascertain if the reaction between a known dilution of rabbit-serum and a certain dilution of serum of alcohol-users and non-drinking persons is different or not, and if the reaction is more apparent with the former or with the latter.

3. The resisting power of serum obtained both from alcohol-drinking and from non-drinking persons was further tested by human blood, with the object of discovering whether any difference in reaction existed between the same immune serum and the two kinds of human sera above mentioned.

4. I have studied the problem as to whether the hæmolytic complement in the blood-serum of alcohol-drinking and non-drinking persons is altered in any way by alcohol.

5. The bactericidal power of blood-serum from both alcohol-drinking and non-drinking persons was determined by some experiments.

The above experiments have given the following results :

1. The normal resistance of human red blood-corpuscles appears to be somewhat diminished against a heterogeneous normal serum or an immune serum by the consumption of alcohol, provided that tolerably large equal, or nearly equal, numbers of drinkers and abstainers of both sexes be examined, and the average of resistance be taken on both sides : this last-named precaution being necessary because the resistance of red blood-corpuscles from different human beings varies largely. The difference is often greater when using weaker dilutions than when using stronger dilutions of lysin.

2. These experiments have shown the normal hæmolytic power of human blood-serum to be less in the case of alcohol-drinkers than in that of abstainers.

3. The precipitating reaction between a solution of 1 per cent. human blood-serum and different dilutions of immune serum (obtained by immunizing the animals with human blood-serum was greater in the case of drinkers than in that of abstainers.

4. The complement action of human blood-serum, according to these experiments, was greater in the stronger dilutions (0·4 to 0·04) and less in the weaker dilutions (0·02 to 0·0004) in the case of drinkers than in that of abstainers; it was not, however much affected.

5. These experiments have also shown that the bactericidal power of blood-serum against typhoid bacteria was less in the case of drinkers than in that of abstainers.

It seems clear, therefore, that alcohol, even in comparatively small doses, exercises a prejudicial effect on the protective mechanism of the human body.